TRANSPORTATION RESEARCH
BULLETIN
A Publication of Idaho Transportation Department Research

Vol. II, No. 2 **Winter 1999**

Research Advisory Committee Realigned

With the realignment of the Highway Division splitting the Operations Bureau into a smaller Operations Bureau and a new Engineering Bureau, an additional position was added to ITD's Research Advisory Committee (RAC). The realignment of the Highway Division and the concurrent retirements of the Transportation Planning Division Administrator and former Chief of Operations led to a domino affect on the membership of the RAC. With few exceptions, the current members of the RAC either are new faces or are representing a different area of the department.

The current RAC membership through FY 2001 consists of:

- ☐ Bob Smith, Materials - *Chairman*
- ☐ Greg Laragan, Design - *Vice Chairman*
- ☐ Clayton Sullivan, Asst. Chief Engineer-Operations
- ☐ Steve Hutchinson, Asst. Chief Engineer-Engineering
- ☐ Matt Farrar, Bridge
- ☐ Dave Jones, Maintenance
- ☐ Larry Van Over, Traffic
- ☐ Charlie Rountree, Planning
- ☐ Dennis Clark, Environmental
- ☐ Larry Faulkner, Public Transportation (Rotating)
- ☐ Loren Thomas, District 3 Engineer (Rotating)
- ☐ Ed Bala, District 5 Engineer (Rotating)
- ☐ Scott Frey, FHWA - Ex Officio
- ☐ Stephen Loop, Materials - Ex Officio

The three rotating positions will rotate off the committee on July 1, 2001. ❄

Research Presentations Scheduled

Thursday morning June 24th has been selected for the annual presentations of Research Briefs by the Principal Investigators working on current research projects. The presentations will be held in the Annex East Conference Room from 8 AM til Noon. The presentations will begin at 8:30 AM and are open to all interested personnel. ❄

District Materials Engineers Are Appointed Research Liaisons

One of the **Action Items** resulting from Idaho's **Research Management Peer Exchange** last December was directed at increasing the involvement of District personnel in research activities. Specifically, the Action item stated: "Work with the Districts to identify an individual to act as research contact within the District. Actively market the research capabilities in the Districts and at statewide technical meetings."

Department personnel participating in the exchange process raised a number of issues concerning District involvement in research. These included:

- ♦ Need a liaison in District, either primary or secondary responsibility,
- ♦ Need more input from ITD people – Districts – on research needs,
- ♦ Need to show the District personnel how they can be involved in the process,
- ♦ Let District staff know about resources available to them – literature searches, help with problem statements,
- ♦ Need to get people to think of research ideas on day-to-day process when problems occur, and

Continued on Page II, Col. 2

FY 2000 Research Projects Solicited

The official request has gone out for research problem statements for projects to be included in the Department's research program for Federal fiscal year 2000 (October 1, 1999 to September 30, 2000). To be considered for FY 2000 funding, **Problem Statements** should be submitted to Bob Smith, HQ Materials Section, **not later than June 15, 1999.** The Research Advisory Committee is expected to meet to consider first stage problem statements in early July, 1999, and will meet again to rank second stage problem statements in mid August.

Two Stage Review Process Adopted:

Beginning this year, a two-stage review process for research proposals has been adopted. This will require less effort on the part of the submitter in preparing the initial problem statement. The Department's Research Advisory Committee will also be able to initially address the relative importance of the research proposals, focusing on:

- ✓ General problem and need,
- ✓ Specific objectives and/or goals, and
- ✓ Applicable research in progress or related research.

Those **first stage statements** that are approved will be returned to the submitter for development of a more detailed **Scope of Work and Budget** (second stage problem statement). In most cases, university or consultant staff will develop the Scope of Work and Budget for those projects that are suitable for contract research, with the assistance of an ITD Technical Oversight Committee. For those projects in which ITD personnel will perform the research, the principal investigator will develop the Scope of Work and Budget with the assistance of the Technical Oversight Committee.

During the second meeting of the Research Advisory Committee, the projects that made the short list will be ranked in accordance with the relative importance of the problem or need identified and how well they address that problem or need. Based on the funds available, projects will be selected for inclusion into the Research Program based on their relative ranking.

Focus of Research:

While research projects can cover a wide range of transportation disciplines, they should address either directly or indirectly one of the four **Primary Focus Areas** presented in the **Highway Performance Report**. These include:

- ☞ Pavement Condition,
- ☞ Bridge Condition,
- ☞ Highway Congestion,
- ☞ and Highway Safety.

Format of Problem Statements:

Chapter 21 - Research in the **Materials Manual** provides an example of a research problem statement format. Although this format is preferred, a simple description of the problem will also be considered. As a minimum, the problem statement should describe the problem and how it impacts the Department's operations. First stage problem statements should be no more than one page long. An outline of the scope of work needed to solve the problem and an estimate of the time and budget required are preferred, but not needed for first stage problem statements. These issues can be resolved in a second stage statement. ❄

❄ ❄ ❄ ❄ ❄ ❄ ❄

District Liaisons (Cont. from Page I, Col. 2)

- ♦ Look at bringing in people from around state for brain storming session to identify issues to be researched.

The six District Engineers have responded by appointing the District Materials Engineer as their respective Research Liaisons. These liaisons will maintain contact with the various sections within their Districts and assist them in research related activities. It is anticipated that they will be a valuable resource to their fellow employees in ensuring that they are able to receive maximum benefits from the Department's research program in accomplishing their assigned tasks. ❄

New Research Reports in Pipeline

Ten research reports have been recently approved for publication and are currently at various stages of the final editing process. They represent projects carried out for the Bridge Design, Maintenance, Materials and Traffic sections. Upon publication, the reports will be added to the catalog located at the Research web page (www2.state.id.us/itd/materials/research/catalog.asp). The **Abstract** of each of the reports is presented below.

Bridge Design:

Camber Growth in Prestressed Concrete Bridge Girders – FHWA-ITD-RP128 In this study, the author examines existing models for predicting camber growth of precast prestressed concrete bridge girders including the present method utilized by the Idaho Transportation Department (ITD). The camber growth of these girders is affected by time-dependent concrete properties, which include modulus of elasticity, creep and shrinkage. The types of girders and manufacturers' practices are also factors.

To allow a detailed analysis, this study focuses on the types of bridge girders designed by ITD and manufactured by local prestressed concrete plants. As a result, the author proposes a time-dependent model for predicting the camber of precast prestressed concrete bridge girders at any age. The author also develops a simple formula for estimating the camber at erection. The camber that is predicted by both methods is compared to data that were provided by girder manufacturers. The coefficients presented in the simple formula are appropriate for the types of bridge girders designed by ITD and manufactured locally. However, the general procedures described in the time-dependent model provide for the derivation of coefficients suitable elsewhere.

Maintenance:

ITD Update of Winter Maintenance Complement Prediction Model – FHWA-ITD-RP125 Two models that were developed for Idaho Transportation Department in 1989-1990, one for predicting Cost/Benefits for changes in Winter Level of Service and one for Winter Maintenance complement determination were revised to include data up to 1994. The Benefit/Cost computer prediction model was completely rewritten to include the new data on yearly traffic volume and yearly winter maintenance costs. The revised model software was written in Visual Basic and was developed to be compatible with the six maintenance districts computer facilities. An output from a hypothetical change in winter maintenance levels is illustrated. The Average Storm Hours for ten winter seasons (1984-1994) for 42 foreman areas and the six districts were determined. The Average Storm Hours for each of the six districts were compared with the overall state average value. This comparison was then used to recommend priorities for changes in winter complements in the six districts.

Integrated Erosion Control Methods for Highway Construction and Slope Maintenance – FHWA-ITD-RP127 A multi-disciplinary research project was funded in late 1996 to investigate new technologies for erosion and sediment control, including a focus on shallow-seated slope failures. The research utilized an approach involving plant science, geotechnical engineering, and new technology regarding soil biostimulants and organic soil amendments used to enhance low-fertility sites, such as those common to disturbed highway slopes. Field demonstration plots were established and monitored at several locations across southwestern Idaho and northern Idaho. Existing slope failures in the Moscow-Lewiston area were mapped and described for engineering back-analysis and investigation.

The primary goal was to provide technical information and field experiences that would lead to enhanced highway slope design, planning, construction, maintenance, and rehabilitation. Deep-rooted shrub species were identified and transplant studies were conducted to evaluate survivability and potential erosion control benefits. Initial field tests and demonstration plots were

Continued on Page IV, Col. 1

Research Reports (Cont. from Page III, Col. 2)

used to evaluate seeding prescriptions and soil treatments that provide organic matter to enhance biological activity on sterile, disturbed sites. Shallow-seated slope failures were investigated through soil direct-shear testing and engineering back-analysis of existing failures; potential treatments were studied and a case study was conducted for a geosynthetic slope reinforcement system.

Optimal Statewide Roadway Weather Information System – FHWA-ITD-RP138 The purpose of this study was to optimize an initial Remote Weather Information System (RWIS) site plan developed by the Idaho Transportation Department (ITD). Questionnaires were sent to ITD District personnel to obtain information on perceived weather and pavement condition needs, snow and ice control practices employed by the personnel, and weather-related problems in various regions. Additionally, interviews were conducted in each District to further understand the needs. Finally, over 4000 miles of roads in Idaho were traveled to survey in a general sense the highway environment and the potential locations of RWIS sites.

Following the analysis of the information gathered, lists of potential sites in each District were developed and sent to each District for their prioritization of site locations. The resulting lists of prioritized sites were consolidated into a single list of sites for initial implementation. Experience in the use of RWIS and evolving proactive maintenance practices may show that additional sites are necessary. As part of the analysis, additional sources of important weather information were identified, including RWIS sites in Montana, Washington and Oregon.

Developing a formal RWIS implementation plan will be key to successful implementation, as will the management of all aspects of RWIS implementation and operations.

Materials:

Development of a Mechanistic-Based Overlay Design System, Volume I: FLEXOLAY Program Documentation – FHWA-ITD-RP121-I, Vol. I This study presents a mechanistic-based overlay design procedure which incorporates the in-situ pavement layer moduli values evaluated by deflection based non-destructive testing using the Falling Weight Deflectometer. The proposed overlay design procedure addresses the seasonal variation in the State of Idaho and adjusts the moduli values accordingly. The performance of the pavement is calculated in terms of critical strains based on the elastic multi-layer theory. The study adopts the Asphalt Institute fatigue and rutting failure criteria to calculate the life of the pavement. Damage analysis is performed based on the past and the expected future traffic to calculate the required overlay thickness.

The developed procedure has been implemented in an event driven user-friendly computer program named **FLEXOLAY**, which runs under the DOS environment. The programming was done using VISUAL BASIC and FORTRAN computer languages. The program was tested and compared with other overlay design methods using pavement sections from the State of Idaho. It is found that the overlay thickness determined by the **FLEXOLAY** was close to some of the existing methods and far from others depending upon the existing pavement conditions.

Development of a Mechanistic-Based Overlay Design System, Volume II: FLEXOLAY Program User Manual – FHWA-ITD-RP121-I, Vol. II This study presents a mechanistic-based overlay design procedure which incorporates the in-situ pavement layer moduli values evaluated by deflection based non-destructive testing using the Falling Weight Deflectometer. The proposed overlay design procedure addresses the seasonal variation in the State of Idaho and adjusts the moduli values accordingly. The performance of the pavement is calculated in terms of critical strains based on the elastic multi-layer theory. The study adopts the Asphalt Institute fatigue and rutting failure criteria to calculate the life of the pavement. Damage analysis is performed based on the past and the expected future traffic to calculate the required overlay thickness.

The developed procedure has been implemented in an event driven user-friendly computer program named **FLEXOLAY**, which runs under the DOS environment. The programming was done using VISUAL BASIC and FORTRAN computer languages. The program was tested and compared with other overlay design methods using pavement sections from the State of Idaho. It is found that the overlay thickness determined by the **FLEXOLAY** was close to some of the existing methods and far from others depending upon the existing pavement conditions.

WINFLEX for WINDOWS 95 – A Mechanistic-Empirical Overlay Design System for Flexible Pavements: User's Guide and Tutorial Examples – FHWA-ITD-RP121-II This study presents the WINDOWS 95 version of the previously developed FLEXOLAY program by the University of Idaho. It is a mechanistic-based overlay design procedure which incorporates the in-situ pavement layer moduli values evaluated by deflection based non-destructive testing using the Falling Weight Deflectometer. The upgrade was not only a transfer to a new language, but also an enhancement of design features.

In **WINFLEX**, a damage analysis is conducted to assess the remaining life of the existing pavement using fatigue and rutting failure criteria. The program provides the user with the ability to choose from nine different fatigue models and six different rutting models used by agencies around the world. Shift factors account for construction variability, differences between laboratory and actual field state of stress, and other unknown factors. **WINFLEX** also addresses temperature correction for different asphalt, environmental factors, and multiple location designs. Enhancements were also made to the output, printing and storage capabilities. An export feature was added in order to export the output to other Windows applications, such as: MSWord, Excel, and Notepad. **WINFLEX** contains two main codes using two computer languages: Visual Basic 4.0 and FORTRAN Power Station 4.0 (FORTRAN 90).

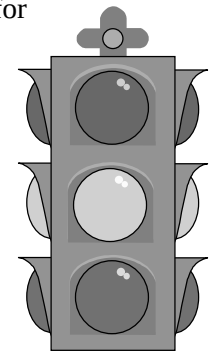
Monitoring and Modeling Subgrade Soil Moisture for Pavement Design and Maintenance in Idaho, Phase 1: Development of Scope of Work – FHWA-ITD-RP124-I The objective of this project was to monitor and evaluate moisture conditions in the subgrade and base in pavement sections constructed with both "Rock Cap" and crushed aggregate base. Frost depth, soil temperature and deflection measurements will be included. With these data, the value of the "Rock Cap" in increasing pavement life and in allowing a thinner surface course will be evaluated. Phase I included 1) identification of instrumentation equipment and development of data collection protocol, 2) identification of pavement sites to reflect different regions of the state and 3) development of work plan and budget for the entire project period (3-5 years).

Traffic:

Applications of Video Based Traffic Detection Systems in Idaho: A Progress Report – FHWA-ITD-RP116B The infrastructure that makes up Intelligent Transportation Systems (ITS) includes elements such as traffic control systems, freeway management systems, and incident management programs. One technology common to these infrastructure elements is machine vision technology, known as video based traffic detection. Video based traffic detection uses computing, video and communications technologies to provide critical information on the operation of a highway or traffic system.

In 1992, the University of Idaho's National Institute of Advanced Transportation Technology (NIATT) developed a laboratory to study video based traffic detection. This report describes the results of six research projects focused on video based traffic detection technology NIATT and ITD have jointly conducted. Video based traffic detection systems produce accuracy levels that are comparable to or exceed results produced by standard in-pavement loop detectors. The systems can be installed without disrupting either traffic flow or the pavement structure. Video based systems are not subject to the same freeze-thaw pavement cycles that commonly break in-pavement loop detector connections. Based on the positive findings, the application of video based traffic systems should be seriously considered for traffic signal control, freeway traffic management and data collection.

Control Strategy for Signalized Intersections – FHWA-ITD-RP132 Corridor traffic signal-timing synchronization is one of the most cost-effective methods for reducing delays and improving the overall operation along a congested corridor for all vehicles. Long delays at a series of signalized traffic intersections on US-95 in northern Idaho connecting Coeur d'Alene to Hayden has generated complaints by the local motorists. Traffic congestion due to the rapid population growth of Coeur d'Alene and long queuing times at critical intersections resulting from large number of visitors during the summer months are



Continued on Page VI, Col. 1

Research Reports (Cont. from Page V, Col. 2

at the heart of these complaints. In order to provide smooth progression and fewer delays along the US-95 and its cross streets, TRANSYT-7F, PASSER II-90, TEAPAC, and CORSIM models were used to study and re-coordinate the signal-timing of the existing twelve coordinated fully actuated controlled intersections.

The research project utilized PASSER II-90 and TRANSYT-7F to optimize progression and minimize delays, respectively, for motorists at all intersections. The PRENETSIM/TEAPAC was then used to create a preliminary input file for the CORSIM simulation model. This file was further calibrated to reflect the field data. The simulation output of the validated CORSIM model produced many measurements of effectiveness (MOE). MOE's such as speed, time delays, and queue length were compared among the EXISTING, APPLIED and PROPOSED signal-timing plans. The PROPOSED signal-timing plan showed significant improvements along the studied corridor. ❄

The **Transportation Research Bulletin** is published quarterly by the Idaho Transportation Depart-ment Research Office. The information, findings, views and recommendations in this publication reflect the views of the authors and are solicited from reliable source. However, they do not necessarily reflect the views of ITD or the FHWA. ITD makes no guarantee and assumes no responsibility for their accuracy, sufficiency or completeness.

Letters or articles are welcome**.**

STAFF

Asst. Mtls./Research Engineer
Bob Smith - 208-334-8437
or bsmith@itd.state.id.us

Editor/Lab Research Engineer
Stephen Loop - 208-334-8267
or sloop@itd.state.id.us

HOME PAGE

www.state.id.us/itd/materials/research/research.asp

Idaho Transportation Department
Post Office Box 7129
Boise, ID 83707-1129